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United States General Accounting Office

Report to the Chairman, C
Post Office and Civil Servi
Representatives

May 1990

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Appraisal and Promotion Resu the U.S. Customs Service

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GAO

United States
General Accounting Office
Washington, D.C. 20548

General Government Division

B-236938

May 18, 1990

The Honorable William D. Ford
Chairman, Committee on
Post Office and Civil Service
House of Representatives

Dear Mr. Chairman:

This report responds to your request, made on behalf of the Subcommittee on Civil Service, that we test the feasibility of analyzing relationships among employee demographics, performance ratings, and promotions. We subsequently agreed with the Subcommittee that due to the exploratory nature of this study we would limit our work to one agency with automated personnel information. The agency we selected—the U.S. Customs Service—had computerized personnel data available for the fiscal year 1987 performance rating period.

The Civil Service Reform Act of 1978 (5 U.S.C. 4302) requires federal agencies to develop performance appraisal systems that provide feedback to employees on the extent to which their job performance meets management expectations. Among other things, the system is intended to help managers determine how well employees are performing and to provide information for such management decisions as promotions and awards.

Background

As the principal border enforcement agency, the U.S. Customs Service is responsible for safeguarding U.S. agriculture, health, and security and for curbing the smuggling of narcotics and contraband into the country. In addition to working at its headquarters location in Washington, D.C., employees of the Customs Service are spread across 7 regional offices, 44 district offices, and approximately 300 points of entry. The majority of the agency's field staff work in white-collar law enforcement positions, such as Customs Inspector and Investigator.

The focus of this report is on Customs employees in two types of pay plans—General Schedule (GS) and General Management (GM). GS, which consists of employees in nonsupervisory positions in grades 1 through 14, comprised 13,197 permanent, full-time employees at U.S. Customs during fiscal year 1987, 66 percent of whom were male and 73 percent of whom were white. GM, which consists of employees in managerial and

supervisory positions in grades 13 through 15, comprised 1,216 employees at Customs, 89 percent of whom were male and 90 percent of whom were white.

The Customs Service uses a five-tiered rating scale to assess the performance of its GS and GM employees. Employees' overall job performance is rated annually at one of the following levels: outstanding, highly successful, satisfactory, minimally successful, and unacceptable.

During fiscal year 1987 less than 1 percent of Customs employees were rated below the satisfactory level. Other studies have shown that infrequent use of low performance ratings is a consistent practice among federal agencies.[1]

Objectives, Scope, and Methodology

The objectives of this assignment were to test whether and to what degree certain federal employee characteristics were related to performance ratings and competitive promotions. The U.S. Customs Service was selected for study because it possessed computerized personnel data that were relatively current and complete. Also, performance ratings were fairly well distributed across three ratings levels (satisfactory, highly successful, and outstanding).

The U.S. Customs Service provided us with a computer tape containing personnel data for fiscal year 1987, which was the most recent performance rating period for which data were available at the time we began this study. The computer tape included demographic, ratings, and personnel action data on permanent, full-time GS and GM employees at Customs as of July 6, 1987. It also covered personnel actions pertaining to these employees through August 25, 1988. We verified the accuracy of the Customs automated data for a random sample of 100 cases and considered the error rate to be reasonable—less than 2 percent. We were unable to verify ethnicity data, as this information was absent from individual personnel files.

[1] A 1988 governmentwide study by the Merit Systems Protection Board, based on 1984 performance ratings data for 846,630 GS and GM employees, found that less than 1 percent of employees received either minimally successful or unacceptable ratings—Toward Effective Performance Management in the Federal Government, Merit Systems Protection Board (Washington, D.C.: July 1988). Also, a study of Performance Management and Recognition System (PMRS) employees in the General Services Administration found that performance ratings below fully successful were given to 1 percent of 487 employees in 1985, .2 percent of 398 employees in 1986, and .9 percent of 352 employees in 1987—J. L. Perry, B. A. Petrakis, and T. K. Miller, "Federal Merit Pay, Round II: An Analysis of the Performance Management and Recognition System," Public Administration Review, Vol. 49, No. 1, Jan/Feb 1989.

We used loglinear statistical techniques to analyze the odds of receiving higher versus lower ratings and the odds of being competitively promoted depending on various employee characteristics. We analyzed ratings and promotions in relation to employees' age, sex, ethnicity, work location, grade level, and time in grade for both GS and GM employees. As a measure of time in grade, we used "step in grade" in the GS analyses and "years in grade" in the GM analyses. We took this approach because step data were not available for both groups.

Using loglinear techniques allowed us to determine which factors were statistically significant at the .05 level in predicting rating levels and promotions and how these factors interacted with one another. The strength of this particular statistical approach is that multiple variables can be analyzed simultaneously, thereby enabling us to examine complex relationships in the data. The technical appendix provides more detailed information on our methodology, the loglinear models tested, and the results obtained.

Results from our work cannot be generalized to other federal agencies, nor can they be used alone to draw conclusions about Custom's personnel management practices. Our work was done from January to September 1989 and in accordance with generally accepted government auditing standards.

Results in Brief

We found that age was directly related to GS employee ratings, whereas other variables (sex and ethnicity, sex and grade, and step in grade and grade) had indirect relationships.[2] With respect to GM performance ratings, we found that age, grade, and years in grade each had direct relationships with ratings, whereas sex and ethnicity had indirect relationships.

For promotions, we found mostly indirect relationships in GS employee data. Indirect relationships included sex and age, sex and location, ratings and location, and ratings and grade. Only step had a direct relationship with GS promotions. In contrast, we found only direct relationships with GM promotions. In the GM group, ethnicity, sex, rating, age, grade,

[2]A direct relationship exists when, after we control for the influences of other factors, the outcome variable (e.g., performance rating) depends on the category of the independent variable (e.g., field or headquarters). An indirect relationship exists when, after we control for the influences of other factors, two or more variables jointly influence the outcome (e.g., being promoted depends on whether one is a black male or female or a white male or female).

years in grade, and location each had a direct relationship with the odds of being promoted.

Although the findings should not be used to draw cause-effect conclusions, they are useful in revealing what combinations of factors were significantly related to ratings and permanent competitive promotions at Customs. Thus, the findings can provide useful insights into the potential dynamics of ratings and promotion decisions and indicate directions for more in-depth work.

Statistically Significant Relationships Existed Between Certain Employee Characteristics and Performance Ratings

Our analyses of GS data sought to determine which of our test factors differentiated between those 5,654 employees (58 percent) rated outstanding or highly successful and those 4,109 (42 percent) rated satisfactory. The GM analyses sought to determine which factors differentiated among the 175 employees (16 percent) rated outstanding, the 636 (58 percent) rated highly successful, and the 287 (26 percent) rated satisfactory.[3] The ratings analyses covered 74 percent of the 13,197 GS employees and 90 percent of 1216 GM employees. These are the employees for whom we had complete data on age, ethnicity, sex, grade, step (or years in grade), and work location. The factors having statistically significant relationships with performance ratings, after we controlled for the influences of other factors, are as follows.

GS Employees

Age. Employees under age 40 had 1.3 times greater odds of being rated highly than those 40 and over.

Ethnicity, sex. White females had 1.3 times greater odds of being rated highly than nonwhite females. White males, on the other hand, had the same odds of being rated highly as nonwhite males.

Grade, ethnicity, sex. In grades 1 through 10 and 13 through 14, white females had 2.1 times greater odds of being rated highly than white males. Similarly, nonwhite females in those grades had 1.7 times greater odds of being rated highly than nonwhite males. Differences in grades 11 through 12 were much smaller.

[3]In some analyses we combined the outstanding and highly successful rating groups into a "high" rating category. This was done because preliminary analysis revealed that it would simplify the analysis without significantly affecting its results.

GM Employees

Age. Employees under age 50 had 1.8 times greater odds of being rated outstanding rather than highly successful and 1.8 times greater odds of being rated highly successful rather than satisfactory compared to those over age 50.

Ethnicity, sex. Among females, whites had 2.1 times greater odds than nonwhites of being rated outstanding rather than highly successful. Among males, nonwhites had 1.6 times greater odds than whites of being rated satisfactory rather than highly successful.

Grade. Compared to employees in grade 13, those in grades 14 through 15 had 1.6 times greater odds of being rated outstanding rather than highly successful and 1.6 times greater odds of being rated highly successful rather than satisfactory.

Years in grade. Compared to employees who had been in grade for 1 year, employees in grade for 2 to 5 years had 1.9 times greater odds of receiving outstanding rather than highly successful ratings. Compared to employees who had been in grade for 6 or more years, employees in grade for 2 to 5 years had 1.6 times greater odds of receiving highly successful rather than satisfactory ratings.

Statistically Significant Relationships Existed Between Certain Employee Characteristics and Competitive Promotions

Our analyses of GS promotion data sought to determine which factors differentiated between those 1415 employees (17 percent) who were permanently competitively promoted between July 1987 and August 1988 and those 6,892 (83 percent) who were not promoted.[4] The GM analyses sought to determine which factors differentiated between the 138 employees (13 percent) who were permanently competitively promoted and the 954 (87 percent) who were not promoted. The analyses covered 63 percent of 13,197 GS employees and 90 percent of 1,216 GM employees—the employees for whom we had complete data on performance rating, age, ethnicity, sex, grade, step (or years in grade), and work location. The factors having statistically significant relationships with competitive promotions after we controlled for the influences of other factors are as follows.

[4]The promotion analyses excluded employees who were promoted either temporarily or noncompetitively. This was done because one of our main interests was to examine relationships between performance ratings and promotion decisions. Since many employees who are promoted noncompetitively advance automatically if they receive a performance rating level of fully successful or higher, we felt that ratings were less of a factor for them than for those who compete for promotions that are not automatic.

GS Employees

Step. Employees in lower steps had 1.4 times greater odds of being promoted than those in higher steps.

Ethnicity, location. In headquarters locations, whites had 1.4 times greater odds of being promoted than nonwhites. In field locations, whites had .7 times lower odds of being promoted than nonwhites.

Sex, rating, location. Males rated outstanding had 2.3 times greater odds of being promoted if they were in field rather than headquarters locations. In contrast, females rated either highly successful or satisfactory had 2 times greater odds of being promoted if they were in headquarters rather than field locations. Being in field rather than headquarters locations did not affect the promotion odds of females rated outstanding and males rated highly successful or satisfactory.

Grade, rating. Among employees rated outstanding, those in grades 1 through 6 had 1.2 times greater odds of being promoted than those in grades 7 through 14. However, among employees rated highly successful and satisfactory, employees in grades 1 through 6 had 2.0 and 3.0 times greater odds of being promoted, respectively, than employees in grades 7 through 14.

Age, sex, location. Among headquarters employees, females under age 40 had 2.2 times greater odds of being promoted than males in that age range, while females 40 and over had 1.6 times greater odds of being promoted than males in that age range. In contrast, among those under 40 in field locations, there was almost no difference in promotions between males and females. Finally, among those 40 and over in field locations, males had 1.4 times greater odds of being promoted than females.

Rating, grade, location. Employees who were rated highly successful had 2.1 times greater odds of being promoted than those who were rated satisfactory if they were in grades 1 through 6 and 3.1 times greater odds of being promoted if they were in grades 7 through 14. However, when we compared those who received outstanding rather than highly successful ratings, the influence of the higher rating was not as evident. Receiving outstanding rather than highly successful ratings in headquarters decreased the odds of promotion by half for those in grades 1 through 6 and by a factor of 0.8 for those in grades 7 through 14. For lower grades in field locations, being rated outstanding rather than highly successful had no influence on promotions. Only for higher graded employees in the field did outstanding ratings have a positive

influence. For them, the odds of promotion were 1.7 times greater if they received outstanding rather than highly successful ratings.

GM Employees

Age. Employees under age 50 had nearly 3 times greater odds of being promoted than those 50 and over.

Ethnicity. Whites had 2 times greater odds of being promoted than nonwhites.

Sex. Females had nearly 2 times greater odds of being promoted than males.

Grade. Employees in grade 13 had 2.5 times greater odds of being promoted than those in grades 14 through 15.

Years in grade. Those in grade for two or more years had 3.3 times greater odds of being promoted than those in grade for less than 2 years.

Rating. Highly rated employees (i.e., those with either outstanding or highly successful ratings) had 3.9 times greater odds of being promoted than those with satisfactory ratings.

Location. Headquarters employees had 1.5 times greater odds of being promoted than field employees.

Observations

Our analysis indicates that it is feasible to use existing data to examine complex relationships between employee characteristics and such personnel management actions as performance ratings and promotions. Our results indicate that statistically significant relationships existed among the test factors. For example, age, sex, and ethnicity were all found to be related to ratings and permanent competitive promotions.

While loglinear analysis techniques enabled us to determine the extent to which certain factors were related to ratings and promotions, interpretation of what these relationships mean is very difficult. Statistical findings by themselves are not sufficient to draw conclusions about agency practices. Rather, such results either confirm or do not confirm that certain relationships exist between employee characteristics and personnel actions, and they can be used to point to directions for further inquiry. In this respect, the U.S. Customs Service could use our results

as a basis for making more in-depth analyses of these matters to determine why these relationships exist.

Agency Views

We obtained informal comments on the information contained in this report from responsible officials of the U.S. Customs Service. They lauded our methodology as being an excellent exploratory tool for identifying areas for further analysis. However, they expressed concern about three issues that they feared could cast their management practices in a negative light. We have considered Customs' views, but feel that our report appropriately alerts the reader to the limitations of our study and adequately addresses the concerns that Customs raised.

Customs expressed concern about the validity of the ethnicity data used and the possibility that our findings may be misleading because Customs recently discovered coding errors in its data. These errors involved the erroneous coding of an unknown number of nonwhites as whites. We agree that, as in any analysis, the most accurate available data should be used. As discussed in the report, we verified data elements where feasible and found them to be within a 2-percent error tolerance. To check ethnicity data, which could not be directly verified against source documents, we compared the data we obtained from Customs with governmentwide ethnicity data for the same occupations. This comparison showed that the percentage of whites and nonwhites in Customs' GS and GM pay plans were very similar to those of the rest of the government. We therefore accepted Customs data as a reasonable foundation for our analyses. Using the data, we found that loglinear analysis was a feasible approach for identifying patterns in personnel management that may warrant further evaluation.

With respect to Customs' concern over the validity of our findings because of the misclassification of nonwhites as whites, we believe that in all likelihood this misclassification would lead to an underestimation of differences between the two groups. This would occur because mixing the characteristics of one group with those of another would tend to make the two groups more similar, not more distinct. Thus, rather than invalidating our findings, Customs' misclassification of nonwhites as whites would tend instead to produce a lower limit estimate of actual ethnicity differences at Customs.

A second Customs concern pertained to our exclusion of noncompetitive promotions from the analysis. Specifically, Customs officials felt that our findings may have differed had we considered employees who were

promoted noncompetitively through the career ladder. It is correct that our analyses excluded both noncompetitive promotions and temporary competitive promotions. However, one of our main interests was to examine relationships between performance ratings and promotion decisions. Since employees in the career ladder are promoted if they receive a performance rating of fully successful or higher, advancement for them is automatic given a minimum level of performance. In contrast, there is nothing automatic about permanent, competitive promotions, and it was our view that rating levels would factor more prominently in decisions concerning these types of promotions. We revised the report to more clearly explain why we excluded noncompetitive promotions from our promotion analyses.

Customs' third concern was with the fact that because our study did not examine the proportional representation of whites and nonwhites in promotions, it should not be used to draw conclusions about Customs' equal employment opportunity (EEO) practices. We agree. Our promotion analyses focused on the odds of whites and nonwhites being promoted after we controlled for the influences of other factors. We made no attempt to study Customs' compliance with EEO guidelines, and it would be improper to conclude that discriminatory practices were occurring at Customs without further analysis. As discussed in the report, our statistical findings point to areas requiring more in-depth inquiry and by themselves are insufficient to draw conclusions about agency personnel management practices.

As requested, we plan no further distribution of this report until 30 days after its issuance unless you publicly announce its contents earlier. At that time, we will send copies to the Commissioner of the U.S. Customs Service and other interested parties.

The major contributors to this report are listed in appendix II. If you have any questions concerning the content of the report, please call me on 275-5074.

Sincerely yours,

Bernard L. Ungar

Bernard L. Ungar
Director, Federal Human Resource
Management Issues

Contents

Abbreviations

EEO	equal employment opportunity
GM	General Management
GS	General Schedule
PMRS	Performance Management Recognition System

Technical Appendix: Loglinear Methodology and Analysis Results

This appendix provides additional technical detail on our analytical approach to the Customs data. It contains a general description of loglinear methodology, describes the variables analyzed and how they were categorized, and presents the loglinear models tested and results obtained in each analysis.

Data Analysis Approach

We used logit analysis, a form of loglinear modeling, to test associations between various independent variables and two outcome variables: performance ratings and competitive promotions. For each outcome variable, we fit a series of hierarchical logit models that allowed for associations among the factors in the model and varied in terms of the direct and indirect effects they had on the outcome. Using maximum likelihood statistical tests to compare the fit of various models with one another, we were able to make inferences about which factors significantly predicted the outcomes and how the factors interacted with one another.

For each outcome, we selected a preferred statistical model. The preferred model was the simplest model that fit the data and could not be significantly improved by more complex models. The preferred model included those factors that had statistically significant direct and indirect relationships with outcome after we controlled for the influences of other factors. Hence, the estimates we obtained were net effects determined after the association of each variable with all other variables had been taken into account.

On the basis of the preferred model, we estimated both the direction and size of the relationships using odds and odds ratios. The odds indicated the tendency for an outcome to occur given a particular combination of factors (e.g., the odds of being promoted given that an individual was under 50, in grades 14 through 15, and had a satisfactory rating). The odds ratio indicated the size of the effect. For example, if the odds of being promoted were .1 among men and .1 among women, the odds ratio between them would be 1.0, indicating the absence of a relationship between sex and promotion. The more the odds ratio diverges from 1.0, the greater the association.

Our analyses were based on available Customs data on employee characteristics rather than on experimental data collected expressly to test theories of the determinants of job outcomes.

Variables Analyzed

Table I.1 displays the variables included in each analysis and the categories into which the variables were grouped. The purpose of the grouping was to reduce the number of categories into which the outcome variable was divided, thereby increasing the number of individuals in the various categories.

Table I.1: Variables Analyzed and the Categories Into Which They Were Grouped

Variable	Categories used in analysis of GS ratings data	Categories used in analysis of GM ratings data	Categories used in analysis of GS promotions data	Categories used in analysis of GM promotions data
Rating	High (combines outstanding and highly successful) Satisfactory	Outstanding Highly Successful Satisfactory	Outstanding Highly Successful Satisfactory	High (combines outstanding and highly successful) Satisfactory
Promotion	Not applicable	Not applicable	Competitively promoted Not promoted	Competitively promoted Not promoted
Sex	Male Female	Male Female	Male Female	Male Female
Ethnicity	White Nonwhite	White Nonwhite	White Nonwhite	White Nonwhite
Age	Under 40 40 and over	Under 50 50 and over	Under 40 40 and over	Under 50 50 and over
Grade	1-10 11-12 13-14	13 14-15	1-6 7-14	13 14-15
Step/ years in grade[a]	1-4 5-10	Under 2 2-5 Over 5	1 2-5 6-10	Under 2 2 and over
Location	Headquarters Field	Headquarters Field	Headquarters Field	Headquarters Field

[a]Time in grade is indicated by "step" in the GS analyses and "years in grade" in the GM analyses.

We used loglinear analysis to arrive at statistically sound ways of grouping the four ordered variables — step (or years in grade), age, grade, and performance rating. Because associations between independent and outcome variables differed in the various analyses, different categorizations were appropriate. For example, when analyzing the GS data, we compared employees under age 40 with employees 40 and over. When analyzing the GM data, we compared those under 50 with those 50 and over. It made substantive sense to do so, since supervisory and management personnel under the GM system were likely to be older than the nonsupervisory personnel under the GS system. By separately analyzing each ordered variable, we were able to group the categories in such a way as to simplify our analyses of outcomes while maintaining the statistical relationships in the data.

Logit Models Tested and Results Obtained

We did four sets of logit analyses on the Customs data. The analyses sought to determine which factors had statistically significant relationships with performance ratings and promotion outcomes of Customs' GS and GM employees. For each analysis, the models we tested to arrive at a preferred model and the odds and odds ratios resulting from the preferred model are as follows.

GS Performance Ratings

These analyses were based on 9,763 GS employees at U.S. Customs, of whom 58 percent received outstanding ratings and 42 percent received highly successful or satisfactory ratings. We combined the highly successful and satisfactory rating groups because preliminary analyses showed no significant effects of the factors of interest to be rated in one versus the other category. Collapsing highly successful and satisfactory ratings simplified the analysis while retaining nearly the same amount of explanatory power as did the original categories.

Table I.2 shows the loglinear models tested to arrive at the preferred model of performance ratings. The preferred model, Model 29, indicated that age had a direct relationship with ratings, that step and grade had an indirect relationship with ratings, and that grade and ethnicity interacted with sex in affecting ratings. Table I.3 shows the odds and odds ratios resulting from the preferred model.

Table I.2: GS Performance Ratings: Logit Models Tested to Examine Relationships With Sex, Ethnicity, Age, Grade, and Step

Model Number	Models tested[a]							Degrees of freedom	Likelihood ratio chi-square
(1)	[XEAGS]	[R]						47	457.20
(2)	[XEAGS]	[XR]	[ER]	[AR]	[GR]	[SR]		41	88.30
(3)	[XEAGS]	[XR]	[ER]	[AR]	[GR]			42	92.37
(4)	[XEAGS]	[XR]	[ER]	[AR]	[SR]			43	357.66
(5)	[XEAGS]	[XR]	[ER]	[GR]	[SR]			42	112.30
(6)	[XEAGS]	[XR]	[AR]	[GR]	[SR]			42	96.49
(7)	[XEAGS]	[ER]	[AR]	[GR]	[SR]			42	230.16
(8)	[XEAGS]	[XER]	[AR]	[GR]	[SR]			40	83.33
(9)	[XEAGS]	[XAR]	[ER]	[GR]	[SR]			40	84.22
(10)	[XEAGS]	[XGR]	[ER]	[AR]	[SR]			39	73.59
(11)	[XEAGS]	[XSR]	[ER]	[AR]	[GR]			40	82.40
(12)	[XEAGS]	[EAR]	[XR]	[GR]	[SR]			40	87.06
(13)	[XEAGS]	[EGR]	[XR]	[AR]	[SR]			39	85.76
(14)	[XEAGS]	[ESR]	[XR]	[AR]	[GR]			40	88.00
(15)	[XEAGS]	[AGR]	[XR]	[ER]	[SR]			39	81.60
(16)	[XEAGS]	[ASR]	[XR]	[ER]	[GR]			40	86.35
(17)	[XEAGS]	[GSR]	[XR]	[ER]	[AR]			39	76.43
(18)	[XEAGS]	[XER]	[XAR]	[XGR]	[XSR]	[AGR]	[GSR]	32	43.77
(19)	[XEAGS]	[XER]	[XAR]	[XGR]	[XSR]	[AGR]		34	55.58
(20)	[XEAGS]	[XER]	[XAR]	[XGR]	[XSR]	[GSR]		34	48.07
(21)	[XEAGS]	[XER]	[XAR]	[XGR]	[AGR]	[GSR]		33	43.81
(22)	[XEAGS]	[XER]	[XAR]	[XSR]	[AGR]	[GSR]		34	63.39
(23)	[XEAGS]	[XER]	[XGR]	[XSR]	[AGR]	[GSR]		33	46.41
(24)	[XEAGS]	[XAR]	[XGR]	[XSR]	[AGR]	[GSR]		33	49.42
(25)	[XEAGS]	[XER]	[XGR]	[GSR]	[AR]			36	51.51
(26)	[XEAGS]	[XER]	[XGR]	[GSR]	[XAR]			35	48.11
(27)	[XEAGS]	[XER]	[XGR]	[GSR]	[XSR]	[AR]		35	50.74
(28)	[XEAGS]	[XER]	[XGR]	[GSR]	[AGR]			34	47.19
(29)[b]	[XEAGS]	[XER]	[XG_2R]	[G_1SR]	[AR]			38	51.93

[a]The notations used in this table are explained below:
R = Performance Rating (high or satisfactory)
X = Sex (male or female)
E = Ethnicity (white or nonwhite)
A = Age (under 40 or 40 and over)
G = Grade (1-10 or 11-12 or 13-14)
S = Step (1-4 or 5-10)

[b]Model 29 was the preferred model at the .05 significance level. The model states that sex and ethnicity interacted in affecting ratings, that sex and grade (in which the second category of grade was contrasted against the first and third) interacted in affecting ratings, that step and grade (in which the first category of grade was contrasted against the second and third) interacted in affecting ratings, and that age had a direct relationship with ratings.

Table I.3: GS Performance Ratings: Observed and Expected Frequencies, Odds, and Odds Ratios From the Preferred Model

					Observed frequencies	
Sex	Ethnicity	Age	Grade	Step	High[c] rating	Satisfactory rating
Female	White	< 40	1-10	1–4	355	214
				5–10	220	114
			11-12	1–4	132	43
				5–10	38	16
			13-14	1–4	32	5
				5–10	12	1
		40+	1-10	1–4	110	75
				5–10	309	170
			11-12	1–4	65	29
				5–10	86	36
			13-14	1–4	12	0
				5–10	12	3
	Nonwhite	< 40	1-10	1–4	220	166
				5–10	132	83
			11-12	1–4	66	36
				5–10	12	6
			13-14	1–4	6	2
				5–10	1	1
		40+	1-10	1–4	50	50
				5–10	187	121
			11-12	1–4	31	22
				5–10	27	16
			13-14	1–4	3	2
				5–10	0	2
Male	White	< 40	1-10	1–4	268	358
				5–10	296	222
			11-12	1–4	368	169
				5–10	169	87
			13-14	1–4	92	23
				5–10	27	9
		40+	1-10	1–4	63	95
				5–10	445	592
			11-12	1–4	196	106
				5–10	642	403
			13-14	1–4	55	31
				5–10	121	56

Expected frequencies[b]		Odds on ratings	Odds ratios[a]					
			Sex	Ethnicity	Age	Grade		Step
High[c] rating	Satisfactory rating	High:[c] Satisfactory	Female: male	White: nonwhite	< 40: 40+	11-12: 1-10	13-14: 11-12	5-10: 1-4
361.01	207.19	1.75	2.1	1.3	1.3			
229.12	104.88	2.19	2.1	1.3	1.3			1.3
129.91	45.09	2.88	1.3	1.3	1.3	1.6		
38.74	15.26	2.54	1.3	1.3	1.3	1.2		0.9
31.92	5.08	6.28	2.1	1.3	1.3		2.2	
11.01	1.99	5.53	2.1	1.3	1.3		2.2	0.9
107.48	77.52	1.39	2.1	1.3				
303.83	175.17	1.73	2.1	1.3				1.3
65.41	28.59	2.29	1.3	1.3		1.6		
81.55	40.45	2.02	1.3	1.3		1.2		0.9
10.00	2.00	5.00	2.1	1.3			2.2	
12.22	2.78	4.40	2.1	1.3			2.2	0.9
219.81	166.19	1.32	1.7		1.3			
134.00	81.00	1.65	1.7		1.3			1.3
69.95	32.05	2.18	1.0		1.3	1.6		
11.84	6.16	1.92	1.0		1.3	1.2		0.9
6.61	1.39	4.76	1.7		1.3		2.2	
1.61	0.39	4.13	1.7		1.3		2.2	0.9
51.22	48.78	1.05	1.7					
174.87	133.13	1.31	1.7					1.3
33.61	19.39	1.73	1.0			1.6		
25.98	17.02	1.53	1.0			1.2		0.9
3.95	1.05	3.76	1.7				2.2	
1.54	0.46	3.35	1.7				2.2	0.9
283.11	342.89	0.83		1.0	1.3			
263.19	254.81	1.03		1.0	1.3			1.3
371.61	165.39	2.25		1.0	1.3	2.7		
170.10	85.90	1.98		1.0	1.3	1.9		0.9
86.03	28.97	2.97		1.0	1.3		1.3	
26.05	9.95	2.62		1.0	1.3		1.3	0.9
62.56	95.44	0.66		1.0				
467.24	569.76	0.82		1.0				1.3
193.52	108.48	1.78		1.0		2.7		
638.72	406.28	1.57		1.0		1.9		0.9
60.39	25.61	2.36		1.0			1.3	
119.49	57.51	2.08		1.0			1.3	0.9

(continued)

Sex	Ethnicity	Age	Grade	Step	Observed frequencies: High[c] rating	Observed frequencies: Satisfactory rating
	Nonwhite	< 40	1-10	1–4	126	129
				5–10	111	138
			11-12	1–4	90	45
				5–10	14	9
			13-14	1–4	14	1
				5–10	2	1
		40+	1-10	1–4	45	55
				5–10	166	221
			11-12	1–4	76	36
				5–10	136	96
			13-14	1–4	7	5
				5–10	7	9

Expected frequencies[b]		Odds on ratings	Odds ratios[a]					
			Sex	Ethnicity	Age	Grade		Step
High[c] rating	Satisfactory rating	High:[c] Satisfactory	Female: male	White: nonwhite	< 40: 40+	11-12: 1-10	13-14: 11-12	5-10: 1-4
112.48	142.52	0.79			1.3			
123.70	125.30	0.99			1.3			1.3
92.11	42.89	2.15			1.3	2.7		
15.05	7.95	1.89			1.3	1.9		0.9
11.09	3.91	2.84			1.3		1.3	
2.14	0.86	2.49			1.3		1.3	0.9
38.52	61.48	0.63						
170.05	216.95	0.78						1.3
70.60	41.40	1.71				2.7		
139.30	92.70	1.50				1.9		0.9
8.31	3.69	2.25					1.3	
10.64	5.36	1.98					1.3	0.9

[a]Due to rounding, the odds ratios may not match precisely those that would be obtained from direct calculation from the expected frequencies.

[b]These values were generated by the preferred model.

[c]High rating combines outstanding and highly successful ratings.

GM Performance Ratings

These analyses were based on 1,098 GM employees on whom we had complete age, grade, sex, ethnicity, years in grade, and performance rating data. Overall, 16 percent were rated outstanding, 58 percent were rated highly satisfactory, and 26 percent were rated satisfactory.

To test relationships between performance ratings and GM employee characteristics, we carried out a series of analyses similar to those for GS employees. However, the way we grouped categories of variables in our GM ratings analyses was not necessarily the same as for GS employees. In Table I.1 for example, there are differences between the GS and GM analyses in how we grouped the age, grade, and ratings variables. Our rationale for such groupings was that they retained much of the original variation in performance ratings while simplifying our work.

Because of the analytical difficulties that arise from trying to look at too many variables simultaneously, we carried out a two-phase analysis procedure. In the first phase, we determined that the sex and ethnicity variables interacted with one another in affecting performance ratings and that their relationships were unrelated to and unaffected by any other variable. (Table I.4 shows the loglinear models pertinent to this

determination and the preferred model identified.) Because sex and ethnicity were related to ratings independently of age, grade, and years in grade, the latter three variables were analyzed separately in the second phase of this work. (Table I.5 shows the loglinear models that test the relationships between age, grade, and years in grade with ratings and the preferred model identified.) The odds and odds ratios from the preferred models are shown in tables I.6 and I.7.

Table I.4: GM Performance Ratings: Logit Models Tested to Examine Relationships With Sex and Ethnicity

Model number	Models tested[a]	Degrees of freedom	Likelihood ratio chi-square
(1)	[ESAGY] [R]	78	161.62
(2)	[ESAGY] [SR]	76	153.00
(3)	[ESAGY] [SR] [ER]	74	151.00
(4)	[ESAGY] [SER]	72	145.02
(5)	[ESAGY] [SR] [AR]	74	124.53
(6)	[ESAGY] [SAR]	72	120.84
(7)	[ESAGY] [SR] [GR]	74	132.50
(8)	[ESAGY] [SGR]	72	132.44
(9)	[ESAGY] [SR] [YR]	72	114.91
(10)	[ESAGY] [SYR]	68	114.15
(11)	[ESAGY] [ER]	76	160.01
(12)	[ESAGY] [ER] [AR]	74	128.06
(13)	[ESAGY] [EAR]	72	127.95
(14)	[ESAGY] [ER] [GR]	74	140.55
(15)	[ESAGY] [EGR]	72	139.84
(16)	[ESAGY] [ER] [YR]	72	120.93
(17)	[ESAGY] [EYR]	68	116.73
(1a)	[ES] [R]	6	16.60
(2a)	[ES] [ER]	4	14.99
(3a)	[ES] [SR]	4	7.98
(4a)	[ES] [ER] [SR]	2	5.98
(5a)	[ES] [ESR]	0	0.00
(6a)[b]	[ES] [$E_1S_1R_1$] [$E_2S_2R_3$]	4	4.15

[a]The notations used in this table are explained below:
R = Performance Rating (outstanding, highly successful, or satisfactory)
E = Ethnicity (white or nonwhite)
S = Sex (male or female)
A = Age (under 50 or 50 and over)
G = Grade (13 or 14-15)
Y = Years in Grade (1, 2-5, or 6 and over)

[b]Model 6a was the preferred model at the .05 significance level. The model states that ethnicity and sex interacted in affecting performance rating. Further, they had the same relationship when comparing outstanding with highly successful as when comparing satisfactory with highly successful. Additional information on linear constraints can be found in Stephen E. Fienberg, The Analysis of Cross-Classified Categorical Data (Cambridge: MIT Press, 1988).

Table I.5: GM Performance Ratings: Logit Models Tested to Examine Relationships With Age, Grade, and Years in Grade

Model number	Models tested[a]				Degrees of freedom	Likelihood ratio chi-square
(1)	[AGY]	[R]			22	101.35
(2)	[AGY]	[AR]	[GR]	[YR]	14	14.78
(3)	[AGY]	[AR]	[GR]		18	47.96
(4)	[AGY]	[AR]	[YR]		16	39.50
(5)	[AGY]	[GR]	[YR]		16	38.36
(6)	[AGY]	[AGR]	[YR]		12	14.68
(7)	[AGY]	[AYR]	[GR]		10	8.94
(8)	[AGY]	[GYR]	[AR]		10	10.15
(9)[b]	[AGY]	[AR_L]	[GR_L]	[YR_L]	18	20.31

[a]The notations used in this table are explained below:
R = Performance Rating (outstanding, highly successful, or satisfactory)
A = Age (under 50 or 50 and over)
G = Grade (13 or 14-15)
Y = Years in Grade (1, 2-5, or 6 and over)

[b]Model 9 was the preferred model at the .05 significance level. The model states that age, grade, and years in grade each had a direct relationship with performance rating. In this model, rating was linearly constrained so that the relationship when we compared outstanding and highly successful was the same as when we compared highly successful and satisfactory.

Table I.6: GM Performance Ratings and Their Relationship With Ethnicity and Sex: Observed and Expected Frequencies, Odds, and Odds Ratios From the Preferred Model

		Observed frequencies		
Ethnicity	Sex	Outstanding	Highly successful	Satisfactory
White	Female	26	51	20
	Male	132	527	233
Nonwhite	Female	3	15	2
	male	14	43	32

Expected frequencies[b]			Odds on ratings	Odds ratios[a]		Odds on ratings	Odds ratios[a]	
				Ethnicity	Sex		Ethnicity	Sex
Outstanding	Highly successful	Satisfactory	Outstanding: highly successful	White: nonwhite	Female: male	Satisfactory: highly successful	Nonwhite: white	Male: female
26.00	49.59	21.41	0.52	2.1	2.1	0.43		
134.44	529.10	228.47	0.25	1.0		0.43		1.0
3.01	11.86	5.12	0.25		1.0	0.43	1.0	
11.55	45.45	32.00	0.25			0.70	1.6	1.6

[a]Due to rounding, the odds ratios may not precisely match those that would be obtained from direct calculation from the expected frequencies.

[b]These values were generated by the preferred model.

Table I.7: GM Performance Ratings and Their Relationship With Age, Grade, and Years in Grade: Observed and Expected Frequencies, Odds, and Odds Ratios From the Preferred Model

			Observed frequencies		
Age	Grade	Years in grade	Outstanding	Highly successful	Satisfactory
<50	13	<2	8	43	35
		2-5	41	137	43
		6+	11	70	35
	14-15	<2	20	54	29
		2-5	51	119	19
		6+	21	56	22
50+	13	<2	0	4	3
		2-5	3	24	18
		6+	6	47	40
	14-15	<2	2	6	2
		2-5	1	24	4
		6+	11	52	37

Expected frequencies[b]			Odds on ratings	Odds ratios[a]				Odds on ratings	Odds ratios[a]			
				Age	Grade	Years in grade			Age	Grade	Years in grade	
Outstanding	Highly successful	Satisfactory	Outstanding: highly successful	< 50: 50+	14-15: 13	2-5: 1	2-5: 6+	Highly successful: satisfactory	< 50: 50+	14-15: 13	2-5: 1	2-5: 6+
7.48	47.48	31.04	.16	1.8				1.53	1.8			
40.35	134.50	46.16	.30	1.8		1.9	1.6	2.91	1.8		1.9	1.6
12.99	67.21	35.81	.19	1.8				1.88	1.8			
15.94	62.13	24.93	.26	1.8	1.6			2.49	1.8	1.6		
54.35	111.22	23.43	.49	1.8	1.6	1.9	1.6	4.75	1.8	1.6	1.9	1.6
18.98	60.30	19.72	.31	1.8	1.6			3.06	1.8	1.6		
0.27	3.10	3.63	.09					0.85				
4.23	25.25	15.52	.17			1.9	1.6	1.63			1.9	1.6
4.87	45.10	43.03	.11					1.05				
0.77	5.37	3.86	.14		1.6			1.39		1.6		
4.80	17.57	6.63	.27		1.6	1.9	1.6	2.65		1.6	1.9	1.6
9.98	56.77	33.25	.18		1.6			1.71		1.6		

[a]Due to rounding, the odds ratios may not precisely match those that would be obtained from direct calculation from the expected frequencies.

[b]These values were generated by the preferred model.

GS Promotions

These analyses were based on 8,307 GS employees for whom we had complete age, grade, step, sex, ethnicity, ratings, location, and promotion data. Overall, 17 percent of the GS employees were permanently competitively promoted between July 1987 and August 1988, and 83 percent were not promoted.

To avoid too many cross-classifications of the data and to facilitate presentation of findings, we again analyzed the data in two stages. In the first stage, we determined that step was directly related to promotion and that ethnicity interacted only with location in affecting promotions. Therefore, age, grade, sex, location, and rating could be analyzed separately in the second stage of the analysis. (Table I.8 shows the loglinear models pertinent to this determination.) The odds and odds ratios from the preferred model are shown in tables I.9 and I.10.

Table I.8: GS Promotions: Logit Models Tested to Examine Relationships With Age, Grade, Step, Sex, Ethnicity, Location, and Performance Rating

Model number	Models tested[a]	Degrees of freedom	Likelihood ratio chi-square
(1)	[RSEAGTL] [P]	360	1081.35
(2)	[RSEAGTL] [RP] [SP] [EP] [AP] [GP] [TP] [LP]	350	451.43
(3)	[RSEAGTL] [RP] [SP] [EP] [AP] [GP] [TP]	351	453.31
(4)	[RSEAGTL] [RP] [SP] [EP] [AP] [GP] [LP]	352	480.83
(5)	[RSEAGTL] [RP] [SP] [EP] [AP] [TP] [LP]	352	545.22
(6)	[RSEAGTL] [RP] [SP] [EP] [GP] [TP] [LP]	351	517.25
(7)	[RSEAGTL] [RP] [SP] [AP] [GP] [TP] [LP]	351	457.50
(8)	[RSEAGTL] [RP] [EP] [AP] [GP] [TP] [LP]	351	451.43
(9)	[RSEAGTL] [SP] [EP] [AP] [GP] [TP] [LP]	352	733.03
(10)	[RSEAGTL] [EP] [AP] [GP] [TP] [LP] [RSP]	348	440.61
(11)	[RSEAGTL] [SP] [AP] [GP] [TP] [LP] [REP]	348	450.77
(12)	[RSEAGTL] [SP] [EP] [GP] [TP] [LP] [RAP]	348	444.32
(13)	[RSEAGTL] [SP] [EP] [AP] [TP] [LP] [RGP]	346	432.89
(14)	[RSEAGTL] [SP] [EP] [AP] [GP] [LP] [RTP]	346	446.62
(15)	[RSEAGTL] [SP] [EP] [AP] [GP] [TP] [RLP]	348	440.62
(16)	[RSEAGTL] [RP] [AP] [GP] [TP] [LP] [SEP]	349	449.47
(17)	[RSEAGTL] [RP] [EP] [GP] [TP] [LP] [SAP]	349	444.95
(18)	[RSEAGTL] [RP] [EP] [AP] [TP] [LP] [SGP]	348	446.56
(19)	[RSEAGTL] [RP] [EP] [AP] [GP] [TP] [STP]	348	450.11
(20)	[RSEAGTL] [RP] [EP] [AP] [GP] [TP] [SLP]	349	431.00
(21)	[RSEAGTL] [RP] [SP] [GP] [TP] [LP] [EAP]	349	449.19
(22)	[RSEAGTL] [RP] [SP] [AP] [TP] [LP] [EGP]	348	445.93
(23)	[RSEAGTL] [RP] [SP] [AP] [GP] [LP] [ETP]	348	450.82
(24)	[RSEAGTL] [RP] [SP] [AP] [GP] [TP] [ELP]	349	437.09
(25)	[RSEAGTL] [RP] [SP] [EP] [TP] [LP] [AGP]	348	447.82
(26)	[RSEAGTL] [RP] [SP] [EP] [GP] [LP] [ATP]	348	448.39
(27)	[RSEAGTL] [RP] [SP] [EP] [GP] [TP] [ALP]	349	450.12
(28)	[RSEAGTL] [RP] [SP] [EP] [AP] [LP] [GTP]	346	442.70
(29)	[RSEAGTL] [RP] [SP] [EP] [AP] [TP] [GLP]	348	437.96
(30)	[RSEAGTL] [RP] [SP] [EP] [AP] [GP] [TLP]	348	451.09
(31)	[RSEAGTL] [TP] [RSP] [RAP] [RLP] [SAP] [SLP] [ELP] [GLP] [RGP]	335	379.29
(32)	[RSEAGTL] [TP] [RAP] [RLP] [SAP] [SLP] [ELP] [GLP] [RGP]	337	382.25
(33)	[RSEAGTL] [TP] [RLP] [SAP] [SLP] [ELP] [GLP] [RGP]	339	387.37
(34)	[RSEAGTL] [TP] [RLP] [SAP] [SLP] [ELP] [RGP]	341	389.93
(35)	[RSEAGTL] [TP] [SAP] [SLP] [ELP] [RGP]	343	398.01
(36)	[RSEAGTL] [AP] [TP] [SLP] [ELP] [RGP] [RLP]	342	395.39

(continued)

Model number	Models tested[a]	Degrees of freedom	Likelihood ratio chi-square
(37)	[RSEAGTL] [TP] [ELP] [RGP] [RLP] [SAP]	342	402.64
(38)	[RSEAGTL] [EP] [TP] [RGP] [RLP] [SAP] [SLP]	342	398.54
(39)	[RSEAGTL] [GP] [TP] [RLP] [SAP] [SLP] [ELP]	345	407.54
(40)[b]	[RSAGL] [R_1LP] [SAP] [SLP] [R_1GP] [R_2GP]	34	41.85

[a]The notations used in this table are explained below:
P = Promoted (competitively promoted or not promoted)
R = Performance Rating (outstanding, highly successful, or satisfactory)
S = Sex (Male or female)
E = Ethnicity (white or nonwhite)
A = Age (under 50 or 50 and over)
G = Grade (1-6 or 7-14)
T = Step (1, 2-5, 6-10)
L = Location (headquarters or field)

[b]Model 40 was the preferred model at the .05 significance level. It is a reduced form of Model 34,which is the preferred model when all eight variables were analyzed simultaneously. On the basis of Model 34, we determined that ethnicity and location could be analyzed separately. Model 40 states that sex interacted with both age and location in affecting promotions and that ratings interacted with both location and grade in affecting promotions.

Table I.9: GS Promotions and Their Relationship With Ethnicity and Location: Observed Frequencies, Odds, and Odds Ratios

		Observed frequencies		Odds on promotion	Odds ratios[a]	
					Ethnicity	Location
Ethnicity	Location	Promoted	Not promoted	Promoted: not promoted	White: nonwhite	HQ: field
White	Headquarters	142	519	.27	1.4	1.5
	Field	806	4448	.18	.7	
Nonwhite	Headquarters	42	209	.20		.8
	Field	425	1716	.25		

[a]Due to rounding, the odds ratios may not precisely match those that would be obtained from direct calculation from the expected frequencies.

Table I.10: GS Promotions and Their Relationship With Rating, Sex, Age, Grade, and Location: Observed and Expected Frequencies, Odds, and Odds Ratios From the Preferred Model

					Observed frequencies	
Rating	Sex	Age	Grade	Location	Not promoted	Promoted
Outstanding	Male	< 40	1–6	HQ	8	3
				Field	42	23
			7–14	HQ	27	8
				Field	83	35
		40+	1–6	HQ	3	0
				Field	46	20
			7–14	HQ	25	5
				Field	65	17
	Female	< 40	1–6	HQ	1	0
				Field	7	6
			7–14	HQ	14	6
				Field	177	93
		40+	1–6	HQ	0	0
				Field	4	2
			7–14	HQ	28	5
				Field	223	66
Highly successful	Male					
		< 40	1–6	HQ	36	14
				Field	179	121
			7–14	HQ	66	18
				Field	275	84
		40+	1–6	HQ	16	3
				Field	158	82
			7–14	HQ	58	14
				Field	274	48
	Female	< 40	1–6	HQ	2	0
				Field	56	29
			7–14	HQ	59	33
				Field	635	198
		40+	1–6	HQ	0	0
				Field	64	9
			7–14	HQ	96	30
				Field	1183	165

Expected frequencies[b]		Odds on promotion	Odds ratios[a]					
							Rating	
Not promoted	Promoted	Promoted: not promoted	Location Field: HQ	Grade 1-6 7+	Age < 50 50+	Sex Female: male	Outstanding: highly successful	Highly successful: satisfactory
8.59	2.41	.28		1.2	1.6		.5	
39.46	25.54	.65	2.3	1.2	1.6		1.0	
28.26	6.74	.24			1.6		.8	
76.15	41.85	.55	2.3		1.6		1.7	
2.55	.45	.18		1.2			.5	
47.06	18.94	.40	2.3	1.2			1.0	
26.13	3.87	.15					.8	
61.11	20.89	.34	2.3				1.7	
.62	.38	.61		1.2	2.2[c]	2.2	.5	
8.02	4.98	.62	1.0	1.2	2.2	1.0	1.0	
13.14	6.86	.52			2.2	2.2	.8	
176.88	93.12	.53	1.0		2.2	1.0	1.7	
0.00	0.00	[d]		1.2[c]		1.6[c]	.5[c]	
4.69	1.31	.28	1.0[c]	1.2		.7	1.0	
26.71	6.29	.24				1.6	.8	
233.62	55.38	.24	1.0			.7	1.7	
31.81	18.19	.57		2.0	1.6			2.1
142.84	117.16	.64	1.1	2.0	1.6			2.1
65.40	18.60	.28			1.6			3.1
272.27	86.73	.32	1.1		1.6			3.1
14.01	4.99	.36		2.0				2.1
171.60	68.40	.40	1.1	2.0				2.1
61.18	10.82	.18						3.1
268.75	53.25	.20	1.1					3.1
.89	1.11	1.25		2.0	2.2[c]	2.2		2.1
52.67	32.33	.61	.5	2.0	2.2	1.0		2.1
56.67	35.33	.62			2.2	2.2		3.1
638.22	194.78	.30	.5		2.2	1.0		3.1
0.00	0.00	[d]		2.0[c]		1.6[c]		2.1[c]
57.19	15.81	.28	.5	2.0		.7		2.1
98.38	27.62	.28				1.6		3.1
1185.12	162.88	.14	.5			.7		3.1

(continued)

					Observed frequencies	
Rating	Sex	Age	Grade	Location	Not promoted	Promoted
Satisfactory	Male	<40	1–6	HQ	37	10
				Field	115	45
			7–14	HQ	34	3
				Field	200	25
		40+	1–6	HQ	18	3
				Field	123	13
			7–14	HQ	45	4
				Field	233	15
	Female	<40	1–6	HQ	2	3
				Field	66	20
			7–14	HQ	43	15
				Field	546	50
		40+	1–6	HQ	2	0
				Field	90	13
			7–14	HQ	108	7
				Field	1320	52

Expected frequencies[b]		Odds on promotion	Odds ratios[a]					
							Rating	
Not promoted	Promoted	Promoted: not promoted	Location Field: HQ	Grade 1-6 7+	Age < 50 50+	Sex Female: male	Outstanding: highly successful	Highly successful: satisfactory
36.84	10.16	.28		3.0	1.6			
122.23	37.77	.31	1.1	3.0	1.6			
33.92	3.08	.09			1.6			
204.22	20.78	.10	1.1		1.6			
17.92	3.08	.17		3.0				
114.07	21.93	.19	1.1	3.0				
46.38	2.62	.06						
233.23	14.77	.06	1.1					
3.12	1.88	.60		3.0	2.2	2.2		
66.36	19.64	.30	.5	3.0	2.2	1.0		
48.37	9.63	.20			2.2	2.2		
543.05	52.95	.10	.5		2.2	1.0		
1.57	.43	.27		3.0		1.6		
90.88	12.12	.13	.5	3.0		.7		
105.54	9.46	.09				1.6		
1314.29	57.71	.04	.5			.7		

[a]Due to rounding, the odds ratios may not precisely match those that would be obtained from direct calculation from the expected frequencies.

[b]These values were generated by the preferred model.

[c]The odds ratio was not directly calculable, but its value could be extrapolated from the model.

[d]The odds could not be calculated for this group.

GM Promotions

We carried out a series of statistical analyses similar to our work on the GS promotion data to test relationships between promotions and GM employee characteristics. These promotion analyses were based on 1,092 GM employees for whom we had complete age, grade, years in grade, sex, ethnicity, ratings, location, and promotion data. Overall, 13 percent of the GM employees were promoted between July 1987 and August 1988 and 87 percent were not.

To simplify our calculations and avoid an expanded cross-classification of the data that would result in many sparse or empty categories, we again did the analyses in two stages. In the first stage, we examined the relationship of ethnicity and sex with promotions. These two variables were examined separately for two reasons. First, there were only 116 females and 107 nonwhites in the Customs GM population. Because of

the small numbers of females and nonwhites, it would have been difficult to work with them in a multidimensional context. Second, preliminary analysis showed that sex and ethnicity were independent of age, grade, years in grade, location, and rating in affecting promotion. Because sex and ethnicity did not interact with these other variables, they could be analyzed separately. In the second stage, we analyzed relationships between promotion and age, grade, years in grade, location, and rating. (Table I.11 shows the loglinear models testing this relationship and the preferred model identified.) The odds and odds ratios from the preferred models are shown in tables I.12 and I.13.

Table I.11: GM Promotions: Logit Models Tested to Examine Relationships With Performance Ratings, Age, Grade, Years in Grade, and Location

Model number	Models tested[a]	Degrees of freedom	Likelihood ratio chi-square
(1)	[RAGYL] [P]	31	107.84
(2)[b]	[RAGYL] [RP] [AP] [GP] [YP] [LP]	26	24.77
(3)	[RAGYL] [RP] [AP] [GP] [YP]	27	28.68
(4)	[RAGYL] [RP] [AP] [GP] [LP]	27	40.67
(5)	[RAGYL] [RP] [AP] [YP] [LP]	27	44.89
(6)	[RAGYL] [RP] [GP] [YP] [LP]	27	43.14
(7)	[RAGYL] [AP] [GP] [YP] [LP]	27	48.82
(8)	[RAGYL] [RAP] [YP] [LP] [GP]	25	24.54
(9)	[RAGYL] [RGP] [AP] [YP] [LP]	25	24.66
(10)	[RAGYL] [RYP] [AP] [GP] [LP]	25	21.84
(11)	[RAGYL] [RLP] [AP] [GP] [YP]	25	22.97
(12)	[RAGYL] [AGP] [RP] [YP] [LP]	25	24.73
(13)	[RAGYL] [AYP] [RP] [GP] [LP]	25	24.06
(14)	[RAGYL] [ALP] [RP] [GP] [YP]	25	24.77
(15)	[RAGYL] [GYP] [RP] [AP] [LP]	25	24.17
(16)	[RAGYL] [GLP] [RP] [AP] [YP]	25	24.77
(17)	[RAGYL] [YLP] [RP] [AP] [GP]	25	21.02

[a]The notations used in this table are explained below:
P = Promoted (competitively promoted or not promoted)
R = Performance Rating (high or satisfactory)
A = Age (under 50 or 50 and over)
G = Grade (13 or 14-15)
Y = Years in grade (under 2 or 2 and over)
L = Location (headquarters or field)

[b]Model 2 was the preferred model at the .05 significance level. The model states age, grade, years in grade, and location each had direct relationships with promotion.

Table I.12: GM Promotions and Their Relationship With Sex and Ethnicity: Observed and Expected Frequencies, Odds, and Odds Ratios From the Preferred Model

		Observed frequencies		Expected frequencies[b]		Odds on promotion	Odds ratios[a]	
							Sex	Ethnicity
Sex	Ethnicity	Promoted	Not promoted	Promoted	Not promoted	Promoted: not promoted	Female: male	White: nonwhite
Female	White	20	77	20.74	76.26	.27	1.9	2.0
	Nonwhite	3	16	2.26	16.74	.14	1.9	
Male	White	110	778	109.26	778.74	.14		2.0
	Nonwhite	5	83	5.74	82.26	.07		

[a]Due to rounding, the odds ratios may not precisely match those that would be obtained from direct calculation from the expected frequencies.

[b]These values were generated by the preferred model.

Table I.13: GM Promotions and Their Relationship With Rating, Age, Grade, Years in Grade, and Location: Observed and Expected Frequencies, Odds, and Odds Ratios From the Preferred Model

					Observed frequencies	
Rating	Age	Grade	Years in grade	Location	Not promoted	Promoted
High[b]	<50	13	1	HQ	11	2
				Field	34	3
			2+	HQ	36	19
				Field	154	49
		14–15	1	HQ	31	5
				Field	36	0
			2+	HQ	110	21
				Field	102	14
	50+	13	1	HQ	2	0
				Field	2	0
			2+	HQ	13	3
				Field	57	7
		14–15	1	HQ	5	0
				Field	3	0
			2+	HQ	44	1
				Field	41	2
Satisfactory	<50	13	1	HQ	3	0
				Field	31	0
			2+	HQ	17	0
				Field	53	8
		14–15	1	HQ	10	0
				Field	18	0
			2+	HQ	18	0
				Field	22	1
	50+	13	1	HQ	2	0
				Field	1	0
			2+	HQ	11	1
				Field	46	0
		14–15	1	HQ	1	0
				Field	1	0
			2+	HQ	15	1
				Field	24	1

Expected frequencies[b]		Odds on promotion	Odds ratio[a]				
			Rating	Age	Grade	Years in grade	Location
Not promoted	Promoted	Promoted: not promoted	High:[c] satisfactory	< 50: 50+	13: 14-15	2+: < 2	HQ: field
11.31	1.69	.15	3.9	3.0	2.5		1.5
33.66	3.34	.10	3.9	3.0	2.5		
36.70	18.30	.50	3.9	3.0	2.5	3.3	1.5
152.63	50.37	.33	3.9	3.0	2.5	3.3	
33.97	2.03	.06	3.9	3.0			1.5
34.63	1.37	.04	3.9	3.0			
109.24	21.76	.20	3.9	3.0		3.3	1.5
102.49	13.51	.13	3.9	3.0		3.3	
1.90	.10	.05	3.9		2.5		1.5
1.94	.06	.03	3.9		2.5		
13.71	2.29	.17	3.9		2.5	3.3	1.5
57.62	6.38	.11	3.9		2.5	3.3	
4.90	.10	.02	3.9				1.5
2.96	.04	.01	3.9[d]				
42.18	2.82	.07	3.9			3.3	1.5
41.18	1.82	.04	3.9			3.3	
2.89	.11	.04		3.0	2.5		1.5
30.22	.78	.03		3.0	2.5		
15.05	1.95	.13		3.0	2.5	3.3	1.5
56.19	4.81	.09		3.0	2.5	3.3	
9.85	.15	.02		3.0			1.5
17.82	.18	.01		3.0[d]			
17.12	.88	.05		3.0		3.3	1.5
22.24	.76	.03		3.0		3.3	
1.97	.03	.02			2.5		1.5
.99	.01	.01			2.5[d]		
11.50	.50	.04			2.5	3.3	1.5
44.72	1.28	.03			2.5	3.3	
.99	.01	.01					1.5[d]
1.00	.00	[e]					
15.73	.27	.02				3.3	1.5
24.72	.28	.01				3.3[d]	

[a]Due to rounding, the odds ratios may not precisely match those that would be obtained from direct calculation from the expected frequencies.

[b]These values were generated by the preferred model.

[c]High rating combines outstanding and highly successful.

[d]The odds ratio was not directly calculable, but its value could be extrapolated from the model.

[e]The odds could not be calculated for this group.

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